Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE
30 SEP 1997

2. REPORT TYPE

3. DATES COVERED
00-00-1997 to 00-00-1997

4. TITLE AND SUBTITLE
The Response of the Upper Ocean to Monsoonal Forcing

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
University of California, San Diego,Scripps Institution of Oceanography,Physical Oceanography Research Division,La Jolla,CA,92093

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**2**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

THE RESPONSE OF THE UPPER OCEAN TO MONSOONAL FORCING

Daniel L. Rudnick
Physical Oceanography Research Division, 0230
Scripps Institution of Oceanography
La Jolla, CA 92093-0230
Award Number N00014-94-1-0251

LONG-TERM GOALS

The primary long-term goal is the quantification of important processes in the upper ocean. To achieve this goal, we need to improve our observational knowledge of air-sea interaction.

OBJECTIVES

The scientific objective of this effort is the observation of the oceanic response to the Arabian Sea monsoons. The primary technological objective is the development of a light-weight meteorological package for deployment on a surface mooring.

APPROACH

The experimental approach has been to deploy two surface moorings as part of a five-mooring array in collaboration with R. Weller of WHOI and C. Eriksen of UW. An SIO mooring includes a surface buoy carrying a meteorological package (MARMET) measuring wind speed and direction, short-wave radiation, air and sea temperatures, and atmospheric pressure. The buoy bridle holds a downward looking 300 kHz Acoustic Doppler Current Profiler (ADCP) measuring horizontal velocity in 4 m bins down to 120 m. Temperature recorders are positioned at 10 m intervals in the upper 50 m and 20 m intervals from 50 to 150 m. The approach in analyzing the data is to use appropriate statistical methods to isolate the ocean’s response to the monsoons.

WORK COMPLETED

The two moorings were successfully deployed during a cruise in October 1994, turned around in April 1995, and recovered in October 1995. We have gotten complete velocity records. The meteorological records are complete except for the loss of wind for six months on one mooring. The temperature data return was 100% for the first six months, with some losses during the second six months. Work during the past year has focused on scientific analysis. An initial report on the unprecedented one-year moored observations was published in Eos.

RESULTS

Analysis during the past year has focused on the vertical shear of horizontal velocity. Shear is a convenient variable to analyze for evidence of wind-driven flow because mooring motion and large-scale geostrophic flow are intrinsically removed. A maximum in shear, as measured by the ADCP in 4 m bins, is evident just beneath the base of the thermal mixed layer. The primarily near-inertial maximum is an important source of energy for mixing the mixed layer. At periods longer than the inertial (45 h), a clear wind-driven spiral becomes apparent. These observations present the most convincing evidence I have seen for an Ekman spiral in two-day averages of shear during the SW monsoon. This very clear signal may be attributed to the directional steadiness of the monsoon. Departures from the Ekman transport relation are due to occasionally strong geostrophic shear.

IMPACT/APPLICATIONS

These observations comprise the first year-long time series of the oceanic response to the Arabian Sea monsoons. The Arabian Sea provides a nearly ideal laboratory for studying the response to a steady wind. The siting of experiments provides what little control oceanographers have over their experiments. In this case the steady wind produced convincing evidence of a nearly instantaneous Ekman spiral.

TRANSITIONS

Our marine meteorological system MARMET forms the central suite of meteorological measurements on the SIO Marine Observatory “monster buoy.”

RELATED PROJECTS

This project is part of the Arabian Sea ARI. My collaborators in the moored program are R. Weller (WHOI), C. Eriksen (UW), T. Dickey (UCSB), and J. Marra and C. Langdon (LDEO).

A collaboration has begun with Piotr Flatau and Maria Flatau on the coupled response of the atmosphere and ocean during the monsoon onset. The Flataus’ work is funded by NSF and NOAA.

REFERENCES

Rudnick, D. L., R. A. Weller, C. C. Eriksen, T. D. Dickey, J. Marra, and C. Langdon, 1997: Moored instruments weather Arabian Sea monsoons, yield data. *Eos, Trans. Amer. Geophys. Union,* **78,** 117, 120-121.

http://chowder.ucsd.edu/arabian/arabian.html